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Commonwealth of Australia
METEOROLOGY
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METEOROLOGY OF AUSTRALIA.

COMMONWEALTH BUREAU OF METEOROLOGY,

MELBOURNE.

MONTHLY DISTRIBUTION OF AUSTRALIAN RAINFALL.

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BULLETIN No. 4.

(ISSUED DECEMBER, 1909.)

Published with the Authority of the Minister of Home Affairs under the direction of

H. A. HUNT,

COMMONWEALTH METEOROLOGIST.

By Authority:
J. KEMP, GOVERNMENT PRINTER, MELBOURNE.

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PREFACE.

This Bulletin with accompanying maps will, it is hoped, serve to indicate the general seasonal distribution of rainfall throughout the Commonwealth.

By its aid, combined with a knowledge of when rains are indispensably required to develop profitably the growth of any class of vegetation, the farmers in settled areas may be able to direct their efforts to greater advantage, not only to their own benefit but to the general wealth of the community.

To the as yet unsettled or partially settled areas of the Commonwealth, it may assist the pioneers or prospectors in the vegetable wealth of the soil as a guide as to what class of crop the distribution of rainfall is most likely to profitably suit. With the exception of cereals, fodder, and sugar, the ultimate possibilities of other vegetable products of the soil may be said to be very poorly gauged in Australia.

Our climatological history of Australia is even to-day very young, and the vagaries of our seasons are very indifferently appreciated or understood. In earlier years this want of knowledge was considerably more, and it may be said that in the absence of climatological information of a practical nature, which the Bureau is endeavouring to supply, the efforts of our pioneers to establish themselves upon the land are, and were, in many cases misdirected; their financial positions were strained and their spirits broken.

These strenuous men by their trials and failures have made Australia what it is to-day. The present landed generation is profiting by the fruits of former adversities and failures. To our present and past settlers battling with the soil, the section of Australian community residing in the cities and towns owes a debt of undying gratitude. We, who reside in the cities surrounded by all the comforts and advantages of a modern civilization, do not generally appreciate, as we should, the fact that to those engaged on the land are we indebted for our livelihoods. The work of this department, particularly, is indebted to inland population, for from it our knowledge of Australian climate and meteorology has been obtained. Many of these indefatigable pioneers, remote from settlement, have furnished invaluable information of past seasons for nearly half-a-century, and it is the aim of the Meteorological Bureau from time to time to so discuss this information, so generously and systematically furnished, in a manner that will tend to still further develop our boundless resources, and, at the same time, endeavour to direct effort to its natural and most effective channels.

In Appendix 1 is presented Dr. Herbertson's notes on the general distribution of rainfall throughout the world, with annotations applying his remarks to Australian rainfall.

In Appendix 2, some graphs and notes on the seasonal distribution of rainfall in New South Wales, by Mr. David Mares, of the New South Wales Divisional Office.

In Appendix 3, the data from which the map was compiled.

In Appendix 4, graphs showing the hourly distribution of rainfall and frequency of showers in Melbourne, Adelaide, Sydney, and Perth for the twelve months ending 30th June, 1909. From these an attempt was made to discover the time rain fell most frequently. It was assumed that during the afternoon, when convectional action is greatest, that the rainfall and frequency would also be at its maximum, and during the same hours in the early morning at its minimum.

It will be seen by reference to the graphs that this anticipation was only justified, and that partially so, by the Melbourne results.

The pluviographs from the other cities are contradictory, but the question may be said to be inconclusively answered since comparable data was only possible for the one year mentioned.

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MONTHLY DISTRIBUTION OF AUSTRALIAN RAINFALL.

The results of a season in Australia, or rather the factors which tend to retard or promote vegetable growth, are complex and varied.

The element of heat necessary for germination, sustaining, and finally for ripening plant life is ample throughout the Commonwealth. The monthly departures from the normal temperatures in most districts are fairly restricted, and only in occasional seasons can the frosts be accounted sufficiently severe to seriously affect the ultimate crop, so that temperature is a factor that need not enter into this discussion.

Setting aside destruction or retardation of growth due to the depredation of rabbits, of loss by bush fires, and occasional visitations of plagues of caterpillars and locusts, and confining our attention to climatic features other than that of temperature, it will be found that elements of rainfall and wind are the two most important with which our prosperity is closely concerned. In discussing our climatological history, a season of heavy rains, or more correctly speaking, an annual rainfall in excess of the average is not always a fact sufficient in itself upon which to assert that the season was a good one. Inversely, an annual rainfall below the normals is not necessarily an indication that the year was a bad or moderate one. Much (in fact it may be fairly claimed everything) depends upon the character and distribution of the rainfalls, combined with the absence of desiccating winds and moderate solar insolation brought about by the intervention of cloud, which enable the moisture to find its way below the surface, which otherwise would be evaporated.

With a system of complete storage for storm waters and run-off for flood, rains would always be acceptable during the winter months; but, unless they are also frequent and fairly abundant in the middle of the summer, spasmodic heavy thunder showers which generally characterize the rain during this time of the year in the interior, are frequently more harmful than beneficial.

The standing feed during the hot months of the year is dry, and unless the rains are exceptional, the visitation of spasmodic thunder squalls has the effect of flattening down this feed where it breaks off level with the ground and it is blown away by the wind after destroying rains have evaporated.

The severe drought in Riverina at the beginning of the year 1908 was considerably aggravated by such a combination of inopportune and violent rains.

Before discussing the mean seasonal distribution of rainfall over Australia, it will at first be advisable to mention briefly the main controlling systems which circulate the rain-bearing winds from the ocean into various parts of the continent.

Australia lies directly in the easterly path of the southern anticyclonic or high-pressure belt, and from this circumstance a great portion of Australia is regarded as being situated in a dry sub-tropical zone of the southern hemisphere. Fortunately, this belt is subject to daily and seasonal oscillation, amounting to several hundreds of miles to and from the equator. The fact has not yet been definitely established, but it is held that our dry seasons are coincident with a want of a sufficient northerly and southerly deviation from the mean path (Lat. 33 deg. S.) of this anticyclonic belt, while good seasons are caused by extensive sobbings or surgings of portions of this region of the atmosphere to and from the equator or South Pole during its passage over Australia.

The seasonal deviations from the mean path are due to the power of the sun during its annual transit of the equator, when the atmospheric equator apparently crosses with it, the adjacent belts of the atmosphere being correspondingly displaced. Thus, when the sun progresses towards its northern solstice, the southern anticyclonic belt is drawn towards the equator into lower latitudes with attending dry conditions over the interior of the continent. Simultaneously, and for the same reason, that portion of the Antarctic low-pressure belt normally lying to the south of Australia is also drawn northwards, and intrudes with its accompanying rains from more temperate and humid latitudes, which are precipitated over the southern areas of the continent.

Conversely, when the sun in his apparent movement towards the southern solstice is accompanied by corresponding movements in the atmosphere, the track of the anticyclonic belt is also gradually moved into higher latitudes, and permits the equatorial low-pressure belt to extend or expand over the northern and central latitudinal areas of the continent, precipitating copious rains from its heavily charged humid air currents over the northern half of the continent. These rains are frequently conducted by monsoonal winds to the southern shores of the continent, and occasionally cross the Bass Straits to Tasmania.

This annual displacement in Australia amounts to about 600 miles, the mean track followed during the winter time being approximately parallel to the 30th degree, and during the summer to the 48th, or even a higher latitude.

The Antarctic and tropical low-pressure belts, to which reference is made in the foregoing, may be regarded as the two main rain-bearing factors of Australia. There are several others which may be termed secondary or transitory factors, which are frequently responsible for heavy and occasional flood rains. The more important of these, by reason of their frequency, are the anticyclones when travelling in high latitudes. As they pass over the Southern Ocean instead of crossing the continent, the winds they control circulate over the sea and, consequently, absorb vast quantities of moisture, so that when these winds strike the shores of New South Wales and Queensland, the rains are very general, and at times very heavy, as the result of excessive condensation due to the cooling of the air as it ascends the rising ground, hills, and mountains which extend along the eastern part of the continent from Gabo to Thursday Island.

*Dr. Ward affirms that " As the belt of rains swings back and forth across the equator after the sun, there should be two rainy seasons with the sun vertical, and two dry seasons when the sun is farthest from the zenith, and while the trades blow. These conditions prevail on the equator, and as far north and south of the equator (about 10–12 deg.), as sufficient time elapses between the two zenithal positions of the sun for the two rainy seasons to be distinguished from one another. In this belt, under normal conditions, there is, therefore, no dry season of any considerable duration. The double rainy season is clearly seen in equatorial Africa, and in parts of equatorial South America. The maxima lag somewhat behind the vertical sun

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* "Climate," by Robert De Courcy Ward. John Murray, London.

coming in April and November, and are unsymmetrically developed, the first maxima being the principal one. This

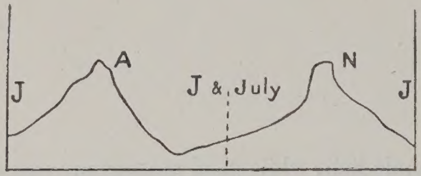

diagram shows the double maxima as experienced in the equatorial zone. Although the extreme northern parts of Australia are within this belt, the double maxima of rainfall are nullified probably by monsoonal conditions."

The next zone of rainfall is the tropical type, which concerns the whole of that portion of Australia north of the tropics, and is said by Dr. Ward to be found where the trade belts are encroached upon by the equatorial rains during the migration of these rains into each hemisphere. It has a maxima and a minima, the former occurring in the summer and the latter in the winter. A reference to the chart showing the monthly distribution will show that at Port Darwin, in the Kimberley district of Western Australia, and in the Carpentaria districts of Queensland, that the maxima occur in January and the minima in July or August. The type does not distinctly operate in other tropical parts of the western State, but is pronounced in Queensland almost to its southern border, the period of maxima, however, being delayed in several areas to February and March, and the minima invariably delayed until August, and in the far south-western parts of Queensland until September. The tropical rainy season in Australia appears to differ from the general rule experienced in other parts of the world, for, while outside Australia the rainy season becomes shorter with increasing distance from the equator, it would appear to become longer in Australia with extensions into higher latitudes.

A casual reference to the map will at once clearly show that the whole of tropical Australia, with the exception of the north-west coast about Onslow, is dominated by a monsoonal distribution of rainfall; or in other words, receives the bulk of its rains during that period of the year when the convectional action in the interior of the continent is at its maximum. Not only are the winds around the northern shores drawn in by this action towards the centre of Australia, but a strong impetus is also there given to the S.E. trades along the entire Pacific shores from the north coastal districts of New South Wales to Thursday Island.

In the central latitudes of Australia it will be noted that while the monsoonal influence still predominates, yet the graphs also demonstrate that the colder months of the year are under the influence of our southern V-shaped depressions, which skirt the southern shores during the winter and spring seasons.

In Western Australia the maxima rainfalls occur in the early and midwinter months over the whole of the western and southern districts. On the gold-fields the distribution is variable, although the preponderance of winter falls is still pronounced.

In South Australia the agricultural areas, including the country adjacent to the Bight, the winter and spring maxima are very marked. In the far north, which is represented by the graphs of Williams Creek and Oodnadatta, the monthly qualities are very erratic.

The pronounced feature of winter rains noted over South Australia and western areas of Western Australia is maintained in western slope districts of New South Wales, but is obscured over Victorian areas south and east of the ranges by the disturbing orographical character of the country.

The same peculiarities may be noted in the central, western, and northern interior of New South Wales. The irregularities, or want of distinctive type, is explained by the fact that these areas are more subject to both tropical and Antarctic rains, and also are particularly prone to spasmodic thundery rains during the summer months.

Roughly, Australia may be divided into three rain belts, viz., summer, winter, and neutral.

The summer rain belt is to the north of the line marked A.A. on the map, the winter belt south of the line marked B.B., and the neutral belt occupies the area between the two.

APPENDIX 1.

1. [*]Dr. Herbertson has given a number of general propositions to be considered in the discussion of rainfall of extensive areas, and has divided the earth up into a number of well-marked bands of high and low rainfalls, as follows :—

(1) Sub-equatorial wet belt.
(2 and 3) Sub-tropical dry belts.
(4 and 5) Temperate wet belts.
(6 and 7) Polar dry caps.

2. He states that these hyetal belts move north and south with the sun.

3. In equatorial regions there are two wet and two dry seasons every year.

4. That most rain falls when the sun is highest at noon, except on the west coasts of temperate lands.

It is now generally admitted that rain can fall steadily, and in considerable quantities, only if there is a steady cooling of the atmosphere, sufficient to neutralize the effect of the increase of temperature due to the liberation of heat when water liquid condenses from water vapour. This is brought about when the air steadily moves from warmer to cooler regions, and the commonest case is that of ascending air. The air may rise from a general convectional movement, such as we find in equatorial regions when the sun is overhead at noon, or from the complicated atmospheric disturbances we call cyclones, or from the interference of a range of mountains with the surface winds, deflecting them into higher regions. The liberation of heat, due to condensation of water vapour, aids the ascending current in convectional movements.

The convectional rains are the most important, and occur when the sun is highest in the heavens. Speaking generally, it may be affirmed that the maximum rainfall occurs at most places in the globe when the sun is nearest the zenith at noon, *i.e.*, in summer at and beyond the tropics, near the equinoxes at the equator, and at intermediate times between summer and the equinoxes at other inter-tropical stations.

There is an obvious exception to this rule in the case of regions within the polar boundary of the sub-tropical dry belt in summer, but within the equatorial limit of the storm rains in winter.

The temperate belt is essentially that of cyclonic rains, but these are coastal and not continental maps.

Unstable conditions of the atmosphere conduce to rain, and are most common where there are great changes in the surface conditions of the earth's surface. This happens along the coastal belt everywhere, and also in mountainous regions with great diversity of level. When both coastal and orographical variations are found together, exceptional unstable atmospheric conditions are the rule, and rainfall is abundant, as in the West Scandinavian or Scottish regions, and in Australasia on the west coast of Tasmania.

The cyclonic conditions are most intensely developed in the temperate zone in winter, and cyclonic precipitation is then a maximum. Along the exposed coasts this cyclonic rainfall is often greater than that of the summer rains, where the cyclonic element is less.[†]

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[*] "The Distribution of Rainfall over the Land," Andrew J. Herbertson, Ph.D., F.R.S.E., John Murray, London.

[†] It is to be noted, however, that convectional conditions occur in cyclonic areas—the area of cyclonic influence being greater and more stable than the migratory cyclones of temperate regions, while the convectional movements probably are minor cyclonic movements within these great cyclonic areas.

The different specific heats of land and water give rise to temperature and pressure differences over the continents and oceans, of great moment in the question of rainfall. The winter cyclones of the temperate belts cannot penetrate far into the interior of the continents where a great high pressure system exists. Hence, although the rains may be heavy on the coasts, they do not spread far inland ; and the rapidly decreasing temperature gradients from the coast to the interior help to intensify the coastal belt rains. In summer, on the other hand, the low-pressure areas over the continents are the goal of steady, if slowly, inflowing winds from all sides. The air gradually rises, and the consequent cooling is more than enough to overcome the influence of a rising temperature gradient.

The summer rains are also, in part, the outcome of the greater vapour capacity of the atmosphere, which increases more rapidly than the temperature, so that the same amount of cooling yields a greater rainfall from saturated air at high than at low temperatures.

Much summer rain has its origin in local evaporation. Outside the regions of inland drainage or permanent drought, the rivers carry away a certain proportion of water to the sea. This water must be replaced if the rainfall is to continue. It can only come from the oceans, and hence a steady, even if a very slow and almost imperceptible, current of vapour must flow into the region of summer rains. If not, desert conditions develop.

To this cause, also, may be ascribed the summer rains of Eastern Queensland, when the S.E. trades are accelerated and ascend under the intense convectional action obtaining in the interior during this time of the year.

It may be well to point out that the line of maximum elevation is not necessarily the boundary of heavy rains. This may lie on the leeward slopes of the mountains, or at some distance from the edge of a plateau. The air may continue to rise for some distance as it moves beyond the ridge, and the maximum precipitation may even occur beyond this line, and not on the windward slope, as has been shown by Mr. Symons in the case at Seathwaite in the English Lake District. But the rainy area on the lee side of a mountain system is distinctly limited to a very narrow strip, which can be shown only on maps drawn to a very large scale.

The raising of the temperature of the descending air explains the drier regions further to leeward.

Mountain barriers explain the existence of most regions not reached by summer rains. The other dry areas are in the trade wind areas, and especially in the centre and west of the continents. The parts of such areas furthest from the equator will also be dry if land stretches polewards from them. This territory, however, receives winter rains, and the areas of permanent dry desert are thus confined to the central and western portions of the trade wind areas, which are not reached either by winter storm rains or by summer zenithal convectional rains.

The polar caps of low rainfall are areas where the temperature is so low most of the year that little vapour can be held in the atmosphere, and so little can be precipitated out of it. The solid water in such regions, moreover, does not melt nor evaporate quickly because of this lowness of temperature.

The deserts of the world are thus divided into two great classes :—(1) Those due to lack of heat, and so only indirectly to lack of moisture, as the polar areas ; and (2) those due to lack of moisture ; and this latter class is of two varieties—(*a*) the deserts with permanent dry winds without any mountain barriers, such as the Sahara, and (*b*) the deserts from which moisture is kept out by great mountain ranges, such as Eastern Turkestan.

It is interesting here to observe in the case of (*b*) that, if our mountain chains were higher, the rains on the windward side would be much heavier ; while in our vast interior on the leeward side, the country would probably have very much lower rain than it enjoys at present.

APPENDIX 2.

SEASONAL RAINFALL DIAGRAMS (N.S.W.).

The following diagrams represent the order in which the seasonal rainfall occurs, on the average, in the various subdivisions of New South Wales. In preparing these graphs, the mean seasonal results of as many available representative stations as possible were utilized, with records ranging, for the most part, from 20 to upwards of 40 years. The figures used for the various graphs were computed from the means of 8 stations on the North Coast, 15 in the Hunter and Manning, 9 on the North-Western Plain, 28 in the Western Division, 12 on Central Tableland, 7 on Northern Tableland, 14 on North-Western Slope, 7 on Central Western Slope, 17 on South-Western Slope, 10 on Central Western Plain, 13 in Riverina, 14 on Southern Tableland, 14 on South Coast, and 5 in the Metropolitan District. The Western Division is capable of subdivision into upper and lower portions, and as shown in the diagrams present interesting features, the upper portion being similar, as regards its seasonal order, to the North-Western Plain which adjoins it, and the lower portion to the Riverina, which is contiguous.

As demonstrated in the diagrams, the North Coast, Hunter and Manning, North-Western Plain, Western Division (as a whole), Central Tableland, Northern Tableland, and North-Western Slope all have their maximum seasonal rainfall in summer ; in the Central Western Slope and Plain, South Coast, and Metropolitan District the autumn rains predominate ; and on the South-Western Slope, Riverina, and Southern Tableland the greatest occurs in winter.

Considered generally, the Western, Northern, and parts of Central areas of New South Wales are indebted to the summer months for the largest seasonal rainfall ; a large area comprising Central parts of the State and the South Coast, to autumn ; and Southern districts west from the Tableland, to winter.

This geographical peculiarity marks the influence of the various weather systems which pass over the State throughout the year.

In Australia the seasons Spring, Summer, Autumn, Winter are represented by the months :—Spring : September, October, November ; Summer : December, January, February ; Autumn : March, April, May ; Winter : June, July, August.

The respective seasonal percentages of mean annual rainfall of the seven various subdivisions of New South Wales are shown to some advantage in the following table :—

Divisions.	Mean Annual.	Spring.	Summer.	Autumn.	Winter.
	Inches.	%	%	%	%
North Coast ..	56.78	17	32.6	31	19.4
Hunter and Manning ..	40.11	20	27	27	25
North-Western Plain	20.42	24	34	19	23
Western Division ..	13.02	23	27	27	23
Central Tableland ..	30.93	23	26	25	26
Northern Tableland ..	34.06	25	34	22	19
North-Western Slope	27.79	25	31	23	21
Central Western Slope	25.21	24	26	26	24
South-Western Slope	24.67	25	21	25	29
Central Western Plain	18.75	21	27	30	22
Riverina	16.27	24	19	28	29
Southern Tableland ..	27.92	25	25	23	27
South Coast ..	38.87	20	25	29	26
Metropolitan ..	39.18	19	26	31	24
Whole State, Mean ..	29.57	23%	27%	26%	24%

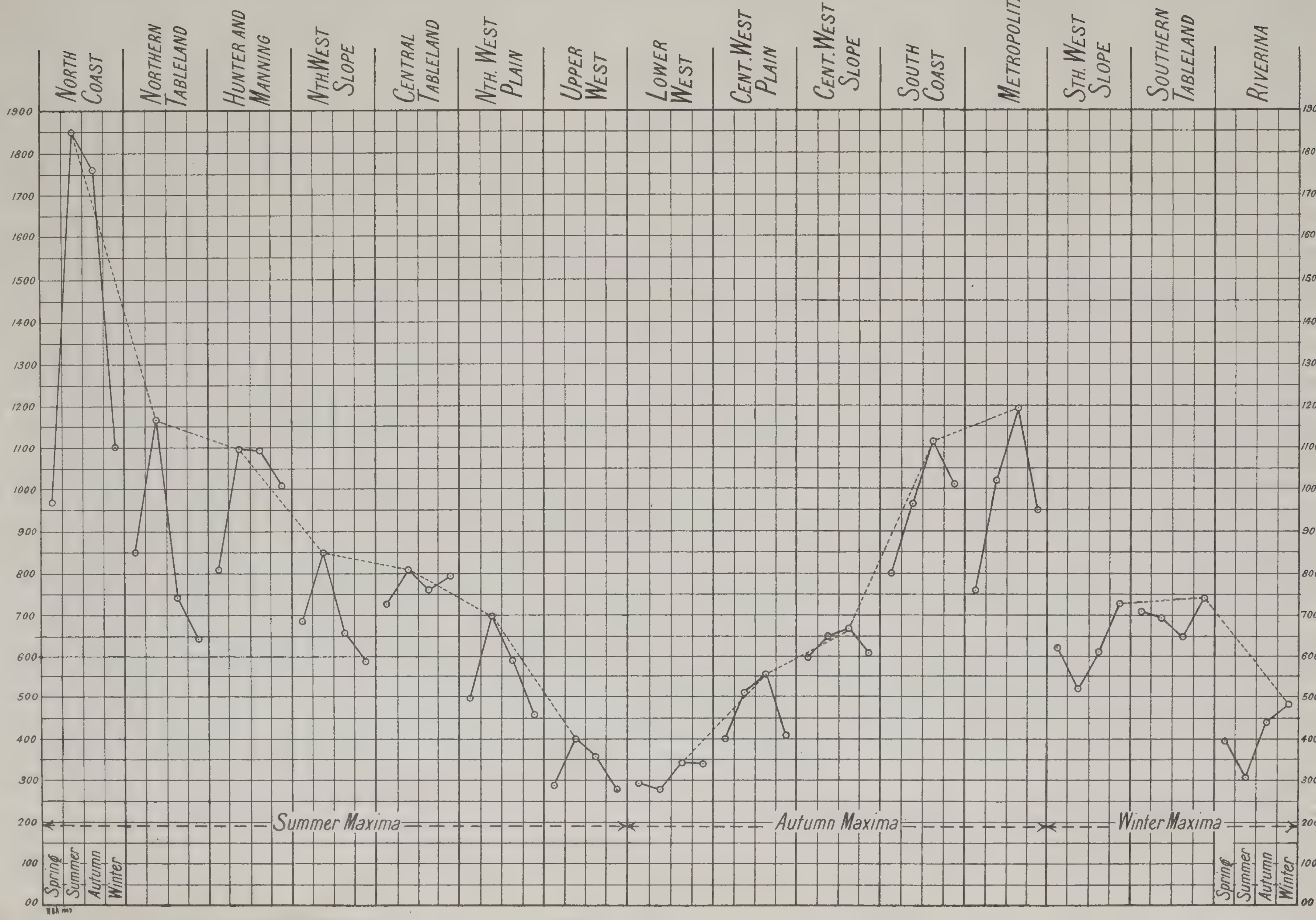
APPENDIX 3.

Commonwealth Meteorology.

Percentages and Mean Monthly and Annual Average Rainfall. (100 = 1 inch.)

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	No. of Years' records.
Stations in West Australia.														
Wyndham	886	598	421	91	33	12	29	0	10	56	234	438	2808	21
	31.5%	21.2%	15.0%	3.2%	1.2%	0.4%	1.0%	..	0.3%	2.0%	8.3%	15.6%		
Hall's Creek	614	469	321	84	50	30	31	1	19	41	125	355	2140	17
	28.7%	21.9%	15.0%	4.0%	2.3%	1.4%	1.4%	..	1.0%	1.9%	5.8%	16.5%		
Broome	571	656	421	91	42	128	29	5	10	4	23	361	2341	18
	24.4%	28.0%	18.0%	4.0%	1.7%	5.5%	1.2%	..	0.4%	..	1.0%	15.4%		
Nullagine	346	184	283	141	45	68	83	55	0	0	45	119	1369	10
	25.0%	13.5%	21.0%	10.0%	3.0%	5.0%	6.0%	4.0%	..	..	3.0%	9.0%		
Onslow	53	70	95	67	175	165	110	49	7	0	2	20	813	22
	6.5%	8.6%	11.6%	8.2%	21.5%	20.3%	13.5%	6.0%	1.0%	..	..	2.4%		
Carnavon	35	53	55	61	103	282	195	65	27	6	5	4	891	25
	4.0%	6.0%	6.0%	6.8%	11.5%	31.6%	21.8%	7.3%	3.0%	..	..	..		
Peak Hill	126	126	180	126	90	129	99	84	27	14	14	45	1060	10
	12.0%	12.0%	17.0%	12.0%	8.5%	12.0%	9.5%	8.0%	2.5%	1.3%	1.3%	4.0%		
Northampton	16	40	43	71	274	485	410	369	226	99	26	15	2074	26
	0.8%	2.0%	2.0%	3.4%	13.2%	23.4%	19.7%	17.8%	10.9%	4.8%	1.2%	0.7%		
Magnet	41	74	91	35	92	125	83	76	54	18	9	22	720	13
	5.7%	10.2%	12.6%	4.8%	12.8%	17.3%	11.5%	10.6%	7.5%	2.5%	1.2%	3.0%		
Lawlers	84	116	59	106	94	130	85	60	52	12	30	40	868	11
	9.7%	13.3%	6.8%	12.2%	10.8%	15.0%	9.7%	7.0%	6.0%	1.4%	3.4%	4.6%		
Laverton	99	100	139	120	134	123	67	52	66	23	49	71	1043	8
	9.5%	9.6%	13.3%	11.5%	12.8%	11.7%	6.4%	5.0%	6.4%	2.2%	4.7%	6.8%		
Walebing	20	40	71	68	225	382	324	302	214	118	48	43	1855	24
	1.1%	2.2%	3.8%	3.6%	12.1%	20.6%	17.4%	16.2%	11.5%	6.3%	2.6%	2.4%		
Coolgardie	36	75	70	52	125	111	78	95	73	61	54	78	908	15
	4.0%	8.2%	7.6%	5.7%	13.7%	12.2%	8.6%	10.4%	8.0%	6.7%	6.0%	8.4%		
Perth	34	34	77	170	490	662	629	564	330	207	78	60	3335	32
	1.0%	1.0%	2.3%	5.1%	14.7%	20.0%	18.8%	17.0%	10.0%	6.2%	2.3%	2.0%		
Kellerberrin	14	25	88	57	149	215	194	158	124	63	31	68	1186	15
	1.2%	2.1%	7.4%	4.8%	12.5%	18.1%	16.3%	13.3%	10.4%	5.3%	2.6%	5.7%		
Katanning	25	50	101	82	207	262	284	233	217	180	49	59	1749	16
	1.4%	2.9%	5.8%	4.7%	11.8%	15.0%	16.2%	13.3%	12.4%	10.3%	2.8%	3.4%		
Esperance	65	66	107	147	276	401	365	392	281	223	97	93	2513	24
	2.6%	2.6%	4.2%	5.8%	11.0%	16.0%	14.5%	15.6%	11.2%	8.8%	3.8%	3.7%		
Eyre	80	40	66	79	145	174	115	118	97	70	65	40	1089	23
	7.3%	3.7%	6.0%	7.2%	13.3%	16.0%	10.5%	10.8%	9.0%	6.4%	6.0%	3.7%		
Stations in South Australia.														
Port Darwin	1543	1313	979	420	83	18	8	9	50	212	498	1022	6155	38
	25.0%	21.0%	16.0%	7.0%	2.0%	..	..	..	1.0%	3.0%	8.0%	17.0%		
Daly Waters	638	675	529	94	16	38	7	11	30	89	201	386	2714	35
	24.0%	25.0%	20.0%	4.0%	1.0%	1.0%	..	..	1.0%	3.0%	7.0%	14.0%		
Tennant's Creek	344	321	200	87	49	23	34	21	38	62	96	243	1518	34
	23.0%	21.0%	13.0%	6.0%	4.0%	1.0%	2.0%	1.0%	3.0%	4.0%	6.0%	16.0%		
Alice Springs	190	174	104	87	65	60	33	42	46	69	87	121	1078	34
	18.0%	16.0%	10.0%	8.0%	6.0%	5.0%	3.0%	4.0%	4.0%	6.0%	8.0%	12.0%		
Oodnadatta	63	86	35	24	22	62	22	13	41	25	37	37	467	16
	14.0%	18.0%	7.0%	5.0%	5.0%	13.0%	5.0%	3.0%	9.0%	5.0%	8.0%	8.0%		
William Creek	63	42	58	50	43	69	22	30	46	35	43	31	532	34
	12.0%	8.0%	11.0%	10.0%	8.0%	13.0%	4.0%	5.0%	8.0%	6.0%	8.0%	7.0%		
Wilgena	49	63	40	58	66	98	47	61	59	53	52	35	681	21
	7.0%	9.0%	6.0%	8.0%	10.0%	14.0%	7.0%	9.0%	9.0%	8.0%	8.0%	5.0%		
Blinman	120	80	84	100	156	172	108	106	119	81	86	82	1294	42
	9.0%	6.0%	7.0%	8.0%	12.0%	13.0%	9.0%	8.0%	9.0%	6.0%	7.0%	6.0%		
Ororoo	110	56	61	115	131	186	127	149	111	115	96	76	1333	35
	8.0%	4.0%	5.0%	9.0%	10.0%	14.0%	9.0%	11.0%	8.0%	9.0%	7.0%	6.0%		

Diagram showing the seasonal distribution of Rainfall in New South Wales



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Percentages and Mean Monthly and Annual Average Rainfall. (100 = 1 inch.)

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	No. of Years' records.
						Stations in South Australia—*continued.*								
Kooringa	79	63	89	140	188	248	213	203	193	172	94	82	1764	49
	4.0%	4.0%	5.0%	8.0%	10.0%	14.0%	12.0%	12.0%	11.0%	10.0%	5.0%	5.0%		
Adelaide	84	59	106	186	274	298	257	233	173	175	103	84	2032	51
	4.0%	3.0%	5.0%	9.0%	14.0%	15.0%	13.0%	11.0%	8.0%	8.0%	5.0%	4.0%		
Eucla	76	50	89	124	123	113	91	88	80	66	68	43	1011	32
	7.0%	5.0%	9.0%	12.0%	12.0%	11.0%	9.0%	9.0%	8.0%	7.0%	7.0%	4.0%		
Streaky Bay	53	45	61	120	191	293	226	188	140	91	71	32	1511	30
	4.0%	3.0%	4.0%	8.0%	13.0%	19.0%	15.0%	12.0%	9.0%	6.0%	5.0%	2.0%		
Cowell	48	39	73	158	131	138	112	128	114	114	60	55	1170	22
	4.0%	3.0%	6.0%	13.0%	11.0%	12.0%	10.0%	11.0%	10.0%	10.0%	5.0%	5.0%		
Cape Borda	71	52	90	210	321	481	403	341	195	153	93	70	2480	39
	3.0%	2.0%	4.0%	8.0%	13.0%	19.0%	16.0%	14.0%	8.0%	6.0%	4.0%	3.0%		
Mt. Gambier	157	93	147	256	346	412	420	412	306	255	183	173	3160	47
	5.0%	3.0%	5.0%	8.0%	11.0%	13.0%	13.0%	13.0%	10.0%	8.0%	6.0%	5.0%		
						Stations in Queensland.								
Thursday Island	1901	1906	1253	862	173	47	29	27	13	32	107	580	6930	18
	27.4%	27.5%	18.1%	12.4%	2.5%	1.0%	0.4%	0.4%	0.2%	0.5%	1.5%	8.4%		
Mein	1348	1042	770	337	38	22	7	12	3	46	232	576	4433	20
	30.4%	23.5%	17.4%	7.6%	1.0%	0.5%	0.1%	0.3%	0.1%	1.0%	5.2%	13.0%		
Fairview	1174	860	674	244	30	28	12	6	24	41	196	518	3807	17
	30.8%	22.6%	17.7%	6.4%	1.0%	0.7%	0.3%	0.2%	0.6%	1.1%	5.1%	13.6%		
Cooktown	1468	1205	1289	880	305	203	83	136	67	65	364	527	6592	19
	22.3%	18.3%	19.5%	13.3%	4.6%	3.1%	1.3%	2.1%	1.0%	1.0%	5.5%	8.0%		
Burketown	947	626	648	82	12	31	9	4	5	26	117	396	2903	19
	32.6%	21.6%	22.3%	2.8%	0.4%	1.1%	0.3%	0.1%	0.2%	0.9%	4.0%	13.6%		
Normanton	1276	992	526	136	38	19	8	15	8	59	197	523	3797	19
	33.6%	26.2%	13.8%	3.6%	1.0%	0.5%	0.2%	0.4%	0.2%	1.5%	5.2%	13.8%		
Georgetown	896	716	416	179	46	36	10	26	47	56	169	580	3177	21
	28.2%	22.5%	13.1%	5.6%	1.4%	1.1%	0.3%	0.8%	1.5%	1.8%	5.3%	18.2%		
Geraldton	2396	2079	2512	2099	1280	579	427	568	303	228	740	1364	14571	22
	16.4%	14.3%	17.2%	14.4%	8.8%	4.0%	3.0%	3.8%	2.0%	1.5%	5.0%	9.4%		
Camooweal	372	343	249	31	26	32	41	26	23	73	91	222	1529	17
	24.2%	22.3%	16.3%	2.1%	1.7%	2.1%	2.7%	1.6%	1.5%	4.7%	5.9%	14.5%		
Cloncurry	459	519	274	81	50	36	50	8	53	52	93	318	1993	19
	22.5%	26.1%	13.7%	4.1%	2.5%	1.8%	2.5%	0.4%	2.7%	2.6%	4.7%	16.0%		
Charters Towers	619	416	393	277	96	119	45	56	88	84	168	305	2666	21
	23.2%	15.6%	14.7%	10.4%	3.6%	4.5%	1.7%	2.1%	3.3%	3.2%	6.3%	11.4%		
Boulia	213	234	156	78	37	41	25	20	43	60	59	143	1109	19
	19.2%	21.4%	14.1%	7.0%	3.6%	3.8%	2.2%	1.8%	4.0%	5.4%	5.4%	13.0%		
Winton	345	302	245	64	78	45	66	15	49	66	84	132	1491	19
	23.2%	20.2%	16.4%	4.3%	5.2%	3.0%	4.4%	1.0%	3.3%	4.4%	5.6%	8.9%		
Longreach	182	454	257	81	152	66	78	21	61	108	83	180	1723	16
	10.6%	26.4%	14.9%	4.7%	8.8%	3.8%	4.5%	1.2%	3.5%	6.3%	4.8%	10.4%		
Clermont	549	482	303	174	140	140	74	93	122	140	132	250	2599	19
	21.1%	18.5%	11.7%	6.7%	5.4%	5.4%	2.8%	3.6%	4.7%	5.4%	5.1%	9.6%		
Banana	478	350	380	131	140	161	134	118	179	222	232	325	2850	19
	16.8%	12.3%	13.3%	4.6%	4.9%	5.6%	4.7%	4.1%	6.3%	7.8%	8.1%	11.4%		
Isisford	318	378	318	194	164	103	77	53	75	101	81	139	2001	19
	15.9%	18.9%	15.9%	9.7%	8.2%	5.1%	3.8%	2.6%	3.7%	5.1%	4.0%	6.9%		
Birdsville	137	92	78	47	53	37	25	25	11	30	22	81	638	14
	21.3%	14.3%	12.2%	7.4%	8.3%	5.8%	3.9%	3.9%	1.7%	4.7%	3.4%	12.7%		
Adavale	277	222	228	104	132	96	62	45	64	99	92	152	1573	19
	17.9%	14.4%	14.7%	6.8%	8.6%	6.1%	4.1%	3.0%	4.3%	6.4%	5.9%	9.9%		
Charleville	214	320	318	170	164	108	77	60	93	143	135	230	2032	19
	10.5%	15.8%	15.6%	8.4%	8.1%	5.3%	3.8%	2.9%	4.6%	7.0%	6.7%	11.3%		
Taroom	395	342	344	188	187	165	133	117	146	183	285	251	2736	19
	14.4%	12.5%	12.6%	6.9%	6.8%	6.0%	4.8%	4.3%	5.3%	6.7%	10.4%	9.2%		
St. George	319	276	247	172	181	130	109	89	146	163	142	197	2171	19
	14.7%	12.7%	11.4%	7.9%	8.3%	6.0%	5.0%	4.1%	6.7%	7.5%	6.5%	9.1%		
Brisbane	667	714	658	397	310	274	239	248	201	283	364	481	4836	49
	13.8%	14.8%	13.6%	8.2%	6.4%	5.6%	4.9%	5.2%	4.1%	5.8%	7.5%	10.0%		

Percentages and Mean Monthly and Average Annual Rainfall. (100 = 1 inch.)

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	No. of Years' records.
Stations in New South Wales.														
Hungerford	186	125	150	97	93	112	55	79	50	100	95	128	1270	24
	14.6%	9.8%	11.8%	7.6%	7.3%	8.9%	4.4%	6.1%	4.0%	7.8%	7.5%	10.0%		
Bourke	195	191	157	137	108	107	86	86	98	109	130	115	1519	36
	12.9%	12.7%	10.3%	9.0%	7.2%	7.2%	5.7%	5.7%	6.6%	7.2%	8.7%	7.8%		
Moree	268	308	255	147	184	177	138	141	174	198	188	183	2361	28
	11.4%	13.0%	10.8%	6.2%	7.8%	7.5%	5.8%	6.0%	7.4%	8.4%	8.0%	7.7%		
Grafton	515	485	478	369	263	251	225	176	192	261	292	355	3862	35
	13.3%	12.5%	12.4%	9.6%	6.8%	6.5%	5.8%	4.6%	5.0%	6.7%	7.6%	9.2%		
Wilcannia	98	71	121	82	111	92	54	86	78	102	57	72	1024	35
	9.6%	7.0%	11.9%	8.0%	10.9%	9.0%	5.3%	8.5%	7.7%	9.9%	5.5%	7.0%		
Cobar	148	147	117	138	132	125	80	119	104	124	123	122	1479	26
	9.9%	9.9%	7.9%	9.3%	8.9%	8.5%	5.2%	8.0%	7.0%	8.5%	8.4%	8.4%		
Manilla	292	239	259	227	187	175	149	148	199	222	260	252	2609	24
	11.2%	9.2%	9.9%	8.7%	7.2%	6.7%	5.7%	5.7%	7.6%	8.5%	10.0%	9.6%		
Kempsey	470	551	522	394	355	364	326	385	255	289	331	431	4673	25
	10.0%	11.8%	11.2%	8.4%	7.6%	7.8%	7.0%	8.3%	5.4%	6.2%	7.1%	9.2%		
Dubbo	191	180	186	197	195	195	155	178	189	171	183	203	2223	35
	8.6%	8.1%	8.4%	8.9%	8.8%	8.8%	7.0%	8.0%	8.5%	7.7%	8.2%	9.1%		
Wentworth	91	65	78	91	117	120	91	104	105	96	97	95	1150	40
	8.0%	5.5%	6.8%	7.9%	10.1%	10.4%	7.9%	9.0%	9.0%	8.2%	8.5%	8.2%		
Hay	86	96	122	138	144	171	118	146	124	122	84	103	1454	27
	6.0%	6.6%	8.5%	9.5%	9.9%	11.9%	8.0%	9.9%	8.7%	8.5%	5.9%	7.0%		
Narrandera	153	117	157	161	155	200	158	164	138	179	124	92	1798	28
	8.5%	6.5%	8.7%	8.9%	8.6%	11.1%	8.8%	9.1%	7.7%	9.9%	6.9%	5.1%		
Goulburn	278	252	214	178	198	204	159	185	215	251	227	233	2594	50
	10.7%	9.7%	8.2%	6.8%	7.6%	7.9%	6.1%	7.1%	8.3%	9.7%	8.7%	9.0%		
Sydney	348	467	522	545	518	542	447	316	287	289	305	248	4834	49
	7.2%	9.7%	10.8%	11.3%	10.7%	11.2%	9.3%	6.5%	5.9%	5.9%	6.3%	5.1%		
Delegate	221	192	251	219	198	294	228	179	214	256	197	221	2670	18
	8.3%	7.2%	9.4%	8.2%	7.4%	11.0%	8.5%	6.7%	8.0%	9.6%	7.4%	8.3%		
Stations in Victoria.														
Hopetoun	55	64	82	112	118	163	108	123	114	102	69	66	1174	11
	4.7%	5.4%	7.0%	9.5%	10.0%	13.8%	9.2%	10.5%	9.7%	8.7%	5.8%	5.6%		
Bendigo	137	108	152	174	207	272	199	212	205	210	153	123	2153	46
	6.4%	5.0%	7.1%	8.1%	9.6%	12.6%	9.2%	9.8%	9.5%	9.7%	7.1%	5.7%		
Colac	176	86	167	233	227	312	258	281	257	284	183	164	2628	23
	6.7%	3.3%	6.3%	8.9%	8.6%	11.9%	9.8%	10.7%	9.8%	10.8%	6.9%	6.2%		
Horsham	79	69	104	152	190	219	155	177	163	179	133	111	1730	34
	4.6%	4.0%	6.0%	8.8%	11.0%	12.7%	8.9%	10.2%	9.4%	10.3%	7.7%	6.4%		
Wodonga	142	101	238	188	216	384	319	238	219	263	166	184	2658	17
	5.3%	3.8%	8.9%	7.1%	8.1%	14.4%	12.0%	8.6%	8.2%	9.9%	6.3%	6.9%		
Omeo	172	218	196	180	195	245	197	200	239	287	209	235	2573	28
	6.7%	8.5%	7.6%	7.0%	7.6%	9.5%	7.6%	7.8%	9.3%	11.1%	8.1%	9.1%		
Warragul	281	141	276	387	333	405	321	385	426	406	309	312	3983	19
	7.1%	3.5%	6.9%	9.7%	8.4%	10.2%	8.1%	9.7%	10.7%	10.2%	7.8%	7.8%		
Melbourne	188	172	213	238	211	209	185	180	231	268	224	224	2543	54
	7.4%	6.8%	8.4%	9.4%	8.3%	8.2%	7.3%	7.1%	9.1%	10.5%	8.8%	8.8%		
Stations in Tasmania.														
Launceston	208	113	167	188	245	342	295	269	299	274	184	188	2772	23
	7.5%	4.1%	6.0%	6.8%	8.8%	12.3%	10.6%	9.7%	10.8%	9.9%	6.6%	6.8%		
Waratah	476	374	521	643	746	950	961	893	887	823	635	544	8453	24
	5.6%	4.4%	6.2%	7.6%	8.8%	11.2%	11.4%	10.6%	10.5%	9.7%	7.5%	6.4%		
Hobart	183	150	162	173	180	216	215	181	209	217	256	187	2329	64
	7.9%	6.5%	6.9%	7.4%	7.7%	9.3%	9.2%	7.8%	9.0%	9.3%	11.0%	8.0%		

By Authority: J. Kemp, Government Printer, Melbourne.

Diagram showing the frequency of showers for the Year ending June 30th 1909

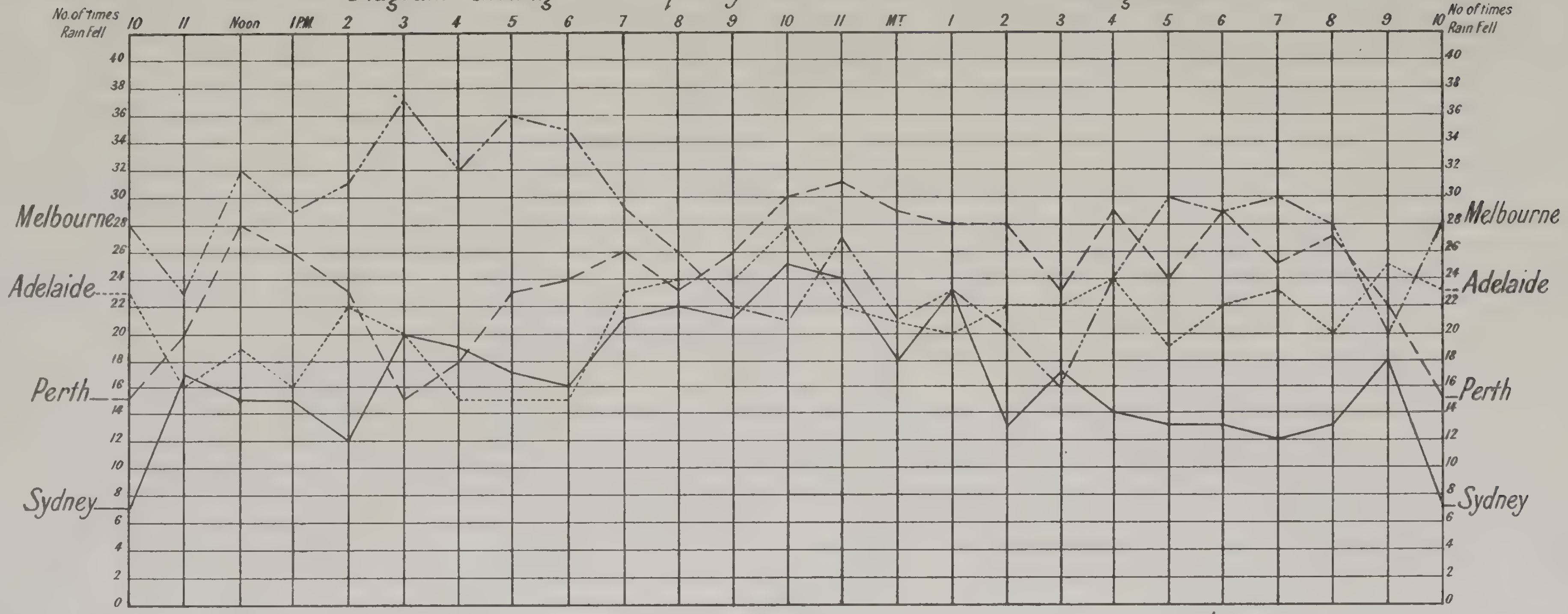
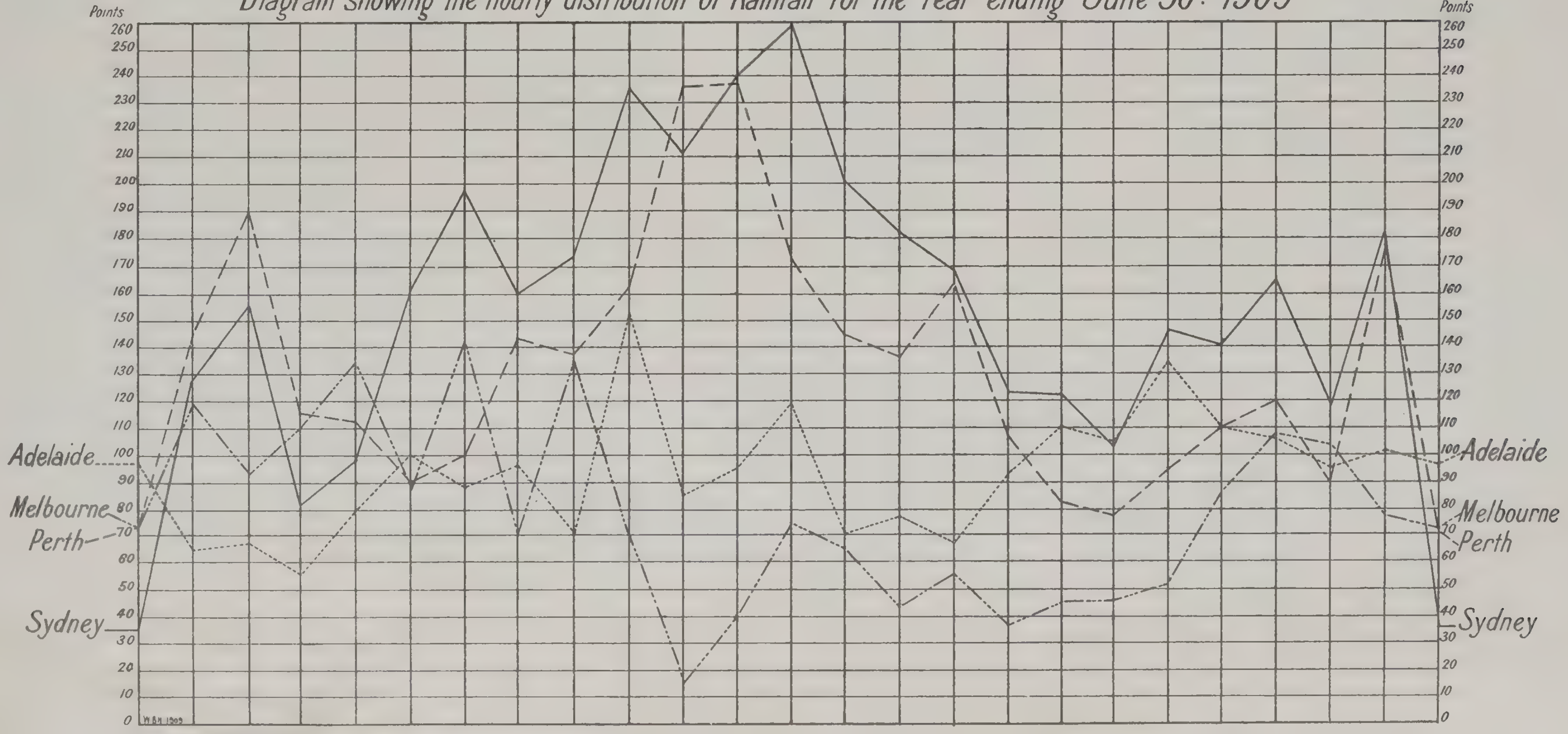


Diagram showing the hourly distribution of Rainfall for the Year ending June 30th 1909



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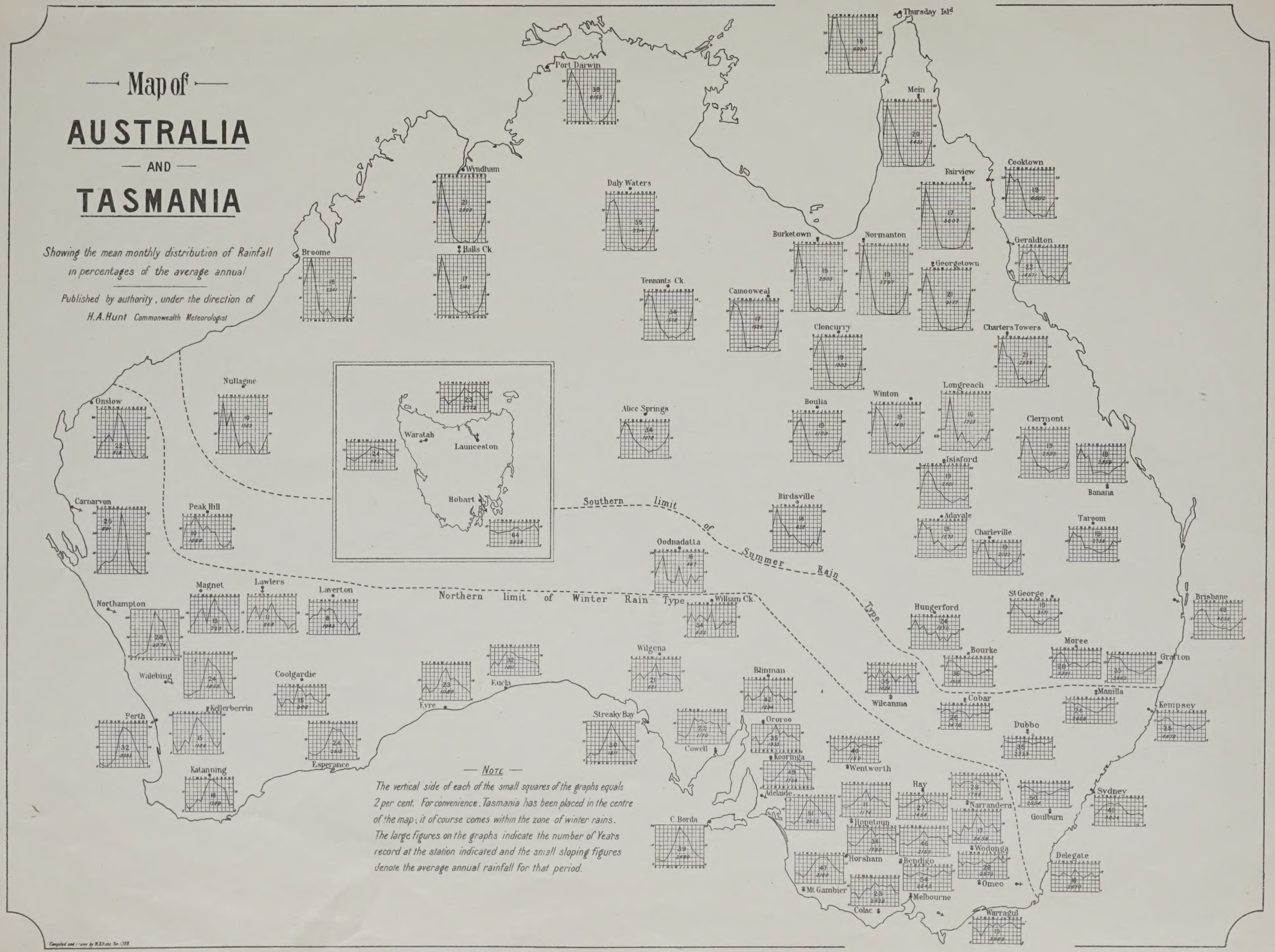
— Map of —
AUSTRALIA
— AND —
TASMANIA

Showing the mean monthly distribution of Rainfall in percentages of the average annual

Published by authority, under the direction of H.A. Hunt Commonwealth Meteorologist



— NOTE —

The vertical side of each of the small squares of the graphs equals 2 per cent. For convenience, Tasmania has been placed in the centre of the map; it of course comes within the zone of winter rains. The large figures on the graphs indicate the number of Years record at the station indicated and the small sloping figures denote the average annual rainfall for that period.

Compiled and drawn by W.B.Hicks Nov 1909

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